HEALTH EDUCATION COUNCIL

THE SCIENTIFIC BASIS OF DENTAL HEALTH EDUCATION

A POLICY DOCUMENT

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Foreword

The Health Education Council's policy document *The Scientific Basis of Dental Health Education* arose out of a joint attempt by the British Association for the Study of Community Dentistry and the Health Education Council to refine and standardise the advice given to the public, and to ensure that such advice was scientifically sound. For a consensus to be reached amongst the experts involved and for the result to be unequivocal, the original 1976 document was of limited scope and depth.

While not wishing to confuse the public, health education messages must evolve in the light of new knowledge and policy must be reviewed periodically. The aim of this revised publication is to take full advantage of more recent evidence on the cause and prevention of dental disease and to provide more detailed and specific advice over a wider range of subjects.

It is hoped that this publication will reach the widest possible audience amongst health professionals. Part 1 has been written for all health care professionals. It contains clear and simple messages that can be passed on to the public, especially to mothers and children. Part 2 is intended mainly for dentists, hygienists and students of dentistry who require more detail of the scientific information and evidence which supports the recommendations made in Part 1.

It is also hoped that as a policy document it may be used by teachers of dentistry to help standardise undergraduate concepts amongst the various dental schools. Finally, it must be recognised that a substantial amount of dental health education material is provided by commercial organisations, much of which is of the highest quality. This too should conform with agreed expert opinion.

Above all, this document is offered in the belief that dental health education is one of the most important responsibilities of the dental profession and it must be approached with the same dedication applied to the treatment of dental disease.

Acknowledgements

The preparation of this document has been greatly assisted by the kind advice of Professors Phillip Holloway and Frank Ashley, respectively former and present Chairman of the Dental Health Advisory Panel of the Health Education Council and Mr Michael Lennon who edited the original document.

In order to ensure the general accuracy of the document a panel of experts was enlisted to comment on the text. While minority views were expressed on some issues, the document reflects the consensus of their opinion. Sincere thanks are due to these experts whose names appear on the final page of the document.

PART 1

A general guide for those involved in dental health education

Dental disease

There are only two major dental diseases. Periodontal (gum) disease and dental caries (tooth decay).

Periodontal disease is a condition which usually begins in childhood, and increases in severity through early adulthood to middle age. The first sign is painless bleeding from the gum margins. If this is left unheeded the bone which supports the tooth root may be attacked and the teeth may eventually become painful and mobile. Although severity varies greatly, about 95% of the adult population exhibit this condition to some degree.

Dental caries (tooth decay) has increased in prevalence during the last 200 years to become a major health and social problem. Its peak incidence is during childhood with 48% of 5 year olds and 93% of 15 year olds affected. Its presentation is all too familiar, with progressive destruction of the crowns of the teeth often accompanied by severe pain and infection.

Today in all western and most developing countries dental disease is accepted as part of the established pattern of life. However we should remind ourselves of three points. Firstly, our ancestors suffered a much lower level of dental decay. Secondly, modern research has confirmed that almost all dental disease is preventable by simple behavioural changes which may be aided by the application of recent scientific developments. Finally, in developed countries and communities such as the UK the prevalence of dental decay is now falling.

Periodontal disease

While there are a number of diseases, both acute and chronic, which affect the gums and bone supporting the teeth (the periodontal tissues), by far the most common is chronic inflammatory periodontal disease. The condition begins, often during childhood, as inflammation of the gum margin, with redness, swelling and bleeding on brushing, a stage known as gingivitis. Without adequate attention gingivitis may slowly give way to chronic periodontitis in which the bone and fibres below the gum which support the tooth are progressively attacked. This may lead to eventual loosening and finally loss of the tooth.

Cause

Periodontal disease is caused by dental plaque, a soft, almost invisible layer of bacteria which forms on the teeth and is present in all mouths (see page 17). The severity of the damage caused by plaque is determined by a number of factors which fall into two groups: those which cause plaque to be retained on the teeth, and those which modify the reaction of the gums to the harmful bacterial products from the plaque.

Plaque retention factors

Any irregularity around the teeth will encourage accumulation of plaque by making tooth cleaning difficult. Such factors include crooked teeth, overhanging edges on fillings and poorly contoured fillings, some types of partial dentures and calculus. Calculus or tartar is plaque which has become calcified. It has a rough surface which is impossible to clean thoroughly. As the condition progresses, the natural shallow crevice between the gum margin and the tooth enlarges to form a periodontal pocket in which plaque accumulates causing further destruction.

Modifying factors

One of the most perplexing aspects of periodontal disease is the wide variation in the rate of destruction of the supporting bone. The indentification of factors

related to this variation is the subject of intensive research. We know that hormonal and metabolic changes are involved but in most cases the cause of the variation is unknown. The hormonal change caused by pregnancy can result in an exaggerated response of the gums to plaque.

Prevention

The main means of limiting periodontal disease is by plaque control. This must be considered at two levels: what people can do for themselves by means of oral hygiene and what dentists and hygienists can do to eliminate plaque retention factors.

Oral hygiene

The single most important oral hygiene measure is toothbrushing. The available evidence indicates that it is the result of toothbrushing which matters most and, provided that plaque is removed effectively and regularly without causing damage, the precise method is less important. Above all, toothbrushing skills should be taught to people of all ages.

There is now ample evidence that the roll toothbrushing technique, which in the past was widely recommended, is, in fact, the least effective method. The scrub technique (see page 18) is more effective for most people and is easier to teach and more readily accepted. Careful use of this method with a recommended type of brush should be encouraged as it will provide effective plaque removal. Most authorities recommend a brush with a small head bearing densely packed soft to medium nylon filaments (see page 18). Regular, effective toothbrushing may be associated with some gingival recession. However, some recession is preferable to the disease caused by plaque.

Plaque disclosing agents can be a useful means of improving oral hygiene techniques but people should be reminded that in themselves they will not remove plaque. The use of dental floss and interdental cleaning aids should be the subject of individual professional advice.

An alternative method of plaque control is the use of antiseptics, of which only chlorhexidine has proven effectiveness. Although this antiseptic is on general sale in the UK in the form of both mouthrinse and toothpaste, on present evidence it cannot be endorsed for long-term unsupervised use (see page 19).

Plaque retention factors

It is the responsiblity of the dentist to ensure that any treatment provided minimises plaque retention and this should be a major factor in treatment planning. Clear advice must be given on the need to clean partial dentures and orthodontic appliances (braces) effectively and regularly. Calculus, which can form both above gum level and within periodontal pockets, should be removed regularly together with residual plaque deposits by careful scaling. The need for this should be made clear to patients. While these factors are important, they are secondary to the priority for effective oral hygiene.

Dental caries

Dental caries is the major disease affecting the tooth itself and its consequence is familiar to most people. The process begins with a small patch of demineralised (softened) enamel at the tooth surface, often hidden from sight in the fissures (grooves) or between the teeth. The destruction spreads into the dentine (the softer, sensitive part of the tooth beneath the enamel). The weakened enamel then collapses to form a cavity and the tooth is progressively destroyed.

Cause

While considerable research is still needed to explain fully the pattern of carious attack (decay), the basic mechanism is beyond doubt. An essential cause of caries is sugar, particularly sucrose, in our diet. Sugar is quickly converted to acid by the bacteria in plaque on the tooth surface. Plaque also serves to hold the acid in contact with the tooth causing demineralisation (the loss of calcium and phosphate from the enamel) and eventual destruction. The pattern and severity of attack are determined by two groups of factors. Those which influence the tooth's resistance to attack and those, in the environment of the tooth, which influence the severity of the attack.

The tooth's resistance

Some people's teeth are more resistant to attack than others, but there is nothing from the nutritional point of view, fluoride apart, that can be done about this. Contrary to popular belief, neither malnutrition in the mother during pregnancy nor in the child after birth appears to have any effect on susceptibility to decay. Thus deficiencies of protein, calcium or vitamins during tooth development have no effect on the prevalence of decay in later life. Neither can calcium be removed from a mother's teeth during pregnancy.

Fluoride is the only factor that has been shown beyond doubt to decrease susceptibility to decay. The effect of fluoride is due partly to its incorporation into the developing tooth before its eruption into the mouth and partly to its direct contact with the tooth after eruption.

The tooth's environment

The important local factors that interact to influence the severity of attack are plaque, saliva and dietary sugar. Plaque is the soft bacterial layer which is found on the teeth particularly in those areas between the teeth and in the pits and fissures which are more difficult to clean. Sugar from the diet passes into the plaque very quickly. Some bacteria in the plaque use this sugar as their source of energy and produce acid as a by-product. It is this acid which causes loss of calcium and phosphate from the tooth. If left unchecked this demineralisation process eventually leads to permanent changes in the tooth surface and its eventual breakdown with the formation of a cavity. Theoretically, any type of sugar can cause decay, but in practice it would appear that those occurring naturally in our food, for example in fruit, have little effect. In contrast much harm is done by sugars added to foods such as cakes, biscuits, pastries, cereals, preserves, confections, soft drinks and other beverages. In the main these sugars are sucrose from cane or beet sugar, and commercial glucose.

However, the mouth does have its own defence mechanisms. While these mechanisms are not fully understood, it seems that saliva also enters the plaque and helps to neutralise the acids. In addition, at the very earliest stages of the decay process, the tooth surface may 'heal' by deposition of calcium and phosphate (remineralisation). Thus, the early decay process may be seen as a contest fought at the tooth surface between, on the one hand, the acids (resulting from the intake of sugar) demineralising the tooth surface and, on the other hand, a number of factors including fluoride and saliva promoting the remineralisation of the tooth surface. This concept of a contest at the tooth surface between those factors producing demineralisation and those favouring natural remineralisation may be useful in considering the prevention of dental caries.

Prevention

There are two aspects to the control of caries, firstly to reduce the severity of attack by trying to eliminate dietary sugar and plaque and secondly, by using

fluoride to increase the tooth's resistance. We must now consider the practicality of these methods.

Diet

When sugar enters the mouth, within seconds acid is generated in the plaque on the tooth surface and a small outflow of mineral from the tooth surface may occur. Within about twenty minutes the acid has been dissipated and the lost mineral may be replaced slowly by the influx of mineral from the saliva or from the diet. However, if sugar is consumed frequently, especially without the presence of other foods or liquids which might dilute or neutralise the acid, then demineralisation may exceed remineralisation and caries will result.

Thus our dietary advice should be to limit the amount, and especially the frequency, of sugar intake and to suggest limiting food and drinks containing sugar to meal-times only. A clear distinction should be drawn between sugar-containing food and drinks and those such as raw fruit or vegetables, nuts, crisps and cheese, which are free of added sugar and can be recommended for between meal snacks. However, nuts should not be given to young children because of the danger of inhalation and crisps in excess should not be given because of the fat and salt content. Mothers of infants should be particularly warned of the dangers of putting sugar-sweetened drinks into feeding bottles or reservoir feeders, especially for the child to hold or go to bed with. Such practices can result in almost continuous enamel demineralisation and severe tooth destruction. People should also be encouraged to study the ingredients of processed food and drinks and to avoid those with added sugar in preference to unsweetened or sugar-free products. Glucose is not an acceptable sugar substitute (see page 16) and its use in infant health drinks and sweets promoted by industry should be condemned together with the use of sugar in medicines.

Plaque control

If it were possible to eliminate plaque completely from the teeth and remove all bacteria from the mouth, then dental caries would not occur irrespective of the amount of sugar consumed. However, such sterilization of the oral cavity is a practical impossibility with the usual oral

hygiene methods however well applied. Indeed, if all bacteria were removed from a tooth surface by brushing, then within minutes more bacteria from the saliva would be deposited and new plaque would begin to form. Normal brushing inevitably leaves some plaque in fissures and other stagnation sites where caries occurs.

This suggestion that caries is beyond the practical control of personal oral hygiene is supported by studies which have failed to establish a clear association between toothbrushing and caries incidence (see page 17). Other suggested methods for plaque removal such as eating fibrous foods including apples and carrots are ineffective. However, plaque can be suppressed using an antiseptic (see pages 7 and 19), but its acceptability for public use and its effectiveness for caries control have yet to be established.

Fluoride

Undoubtedly, the most effective, safe and efficient public health measure for reducing dental caries is the fluoridation of public drinking water at a level of 1 part of fluoride per million parts of water (1 ppm). Such a measure would first ensure that fluoride was taken up into the developing tooth and then that it contacted the erupted teeth over a lifetime.

Fluoride tablets or drops, taken daily from soon after birth, would ensure that the correct amount of fluoride entered the developing tooth, but there are problems in persuading parents to persevere with this. The correct dosage (see page 21) depends on the level of fluoride in the water supply and a parent would be best advised to seek professional advice on dosage before starting tablet administration. It should be stressed that fluoride supplements are a long-term measure and should be given daily until at least adolescence. There would seem little point in pregnant women taking fluoride tablets in an effort to increase the resistance of the teeth of their unborn children as there is insufficient evidence of additional benefit.

The daily use of a fluoride toothpaste provides added protection and to some extent has removed the need for professionally applied fluoride agents such as gels, except in special circumstances (see page 22).

Summary

In the past the information presented to the public by dental health educators has often been unnecessarily complicated, frequently contradictory and sometimes wrong. Today, advice should be based on four simple statements.

Restriction of sugar-containing foods and drinks to meal times

The number of times sugar enters the mouth is the most important factor in determining the rate of dental decay. If confined to meal times, the harmful effects of sugar will be reduced. Food and drinks not containing added sugar may be consumed between meals with little risk of causing decay.

Cleaning the teeth and gums thoroughly every day with a fluoride toothpaste

The removal of dental plaque is essential for the prevention of periodontal disease. The toothbrush is the only means of plaque removal that should be recommended to the public, other oral hygiene aids, apart from disclosing agents, being a matter for personal professional advice. Thorough brushing, every day, is of more value than more frequent cursory brushing, and a careful scrub technique should be advised. The toothbrush size and design should allow the user to reach all tooth surfaces and gum margins easily and comfortably. Regular toothbrushing by itself will not prevent dental decay, but a definite benefit will be gained by the use of a fluoride toothpaste or powder.

Water fluoridation

Fluoridation of the water supply has a profound influence on the dental health of the community and should be implemented at the earliest possible time. Fluoride tablets or drops are an alternative for motivated parents.

Regular dental attendance

Studies on the control of periodontal disease have emphasised the importance of regular professional cleaning in addition to daily plaque removal. It is the dentist's responsibility to ensure that this is carried out

effectively at intervals depending on the needs of individual patients, to monitor the health of the mouth and to provide dental health advice. Once decay is established and a definite cavity is present, it cannot be remineralized, but the tooth can be restored. Whilst many people may need fillings only infrequently, the importance of early detection and treatment makes regular attendance advisable.

PART 2

Additional notes on specific topics

Dietary control

Sugar and dental caries

The evidence for an association between sugar and caries comes from a variety of sources. Epidemiological studies have shown a clear correlation between caries experience and mean sugar consumption levels in different countries. When communities have shown changes in sugar consumption such as in wartime when consumption fell, a corresponding change in caries prevalence has been observed. Similarly, groups having low or restricted sugar consumption and those with high access to or consumption of sugar, show correspondingly higher levels of caries experience. Children using sugar-sweetened medicines over long periods have shown higher caries levels compared to a control group. Human clinical studies have shown that when sugar consumption is increased under controlled conditions, then the caries increment follows. Finally, laboratory studies have demonstrated, by the use of miniature pH electrodes inserted into the plaque on teeth, an immediate fall in pH on the application of neutral sugar solution, with the acidity persisting for 20–40 minutes.

Sugar in food and drinks

Most carbohydrates can be metabolised by the bacteria of dental plaque to form organic acids. However it is the simple sugars, the monosaccharides and disaccharides, which are most rapidly converted. Such sugars are present in the diet as naturally occurring sucrose, glucose and fructose in fruit and vegetables, and as

artifically refined sugar (sucrose) which is added in large amounts to a wide range of processed foods and drinks. While sucrose appears to be the most cariogenic, both glucose and fructose will readily produce caries in animal studies and combinations of sugars appear to be as cariogenic as sucrose alone. Neither does there appear to be a safe level for sugar concentration in food and drinks, as this is linked in a complex manner with physical consistency. Indeed, in solution, sugar concentrations below the taste threshold can generate acid in plaque.

There is considerable evidence that when dietary sugar is consumed during a meal, then the effect on caries development is much reduced. This may be due to both the physical and chemical effects of the other foods in neutralising and diluting the acid generated, together with a stimulation of salivary flow which has a similar effect. Conversely, sugar intakes between meals produce an increase in caries experience.

There is evidence that the physical nature of sugar-containing foods is important in determining relative cariogenicity. Foods with a slow oral clearance rate, such as toffees, may maintain a depressed plaque pH for much longer periods than rapidly cleared foods.

Sugar intake frequency

It is well-established that on ingestion of sugar, acid is rapidly generated in the dental plaque and within 1–2 minutes plaque pH has fallen to levels at which enamel dissolution can occur. The return to neutrality takes between 20 and 40 minutes depending on such factors as salivary flow rate and buffering capacity and probably plaque depth and composition. Large depressions in plaque pH are achieved by modest sugar concentrations *in vitro*, and beyond a certain point increased concentrations do not give a greater fall in pH. However, it follows that a high frequency of sugar intake will not allow time for the pH to recover and for a large proportion of the day the plaque pH will be acidic and demineralisation may exceed remineralisation. These observations are supported by animal experiments which have shown a direct correlation

between frequency of sugar intake and caries levels.

Finally, it has been shown that in human volunteers who had stopped toothbrushing, the introduction of two-hourly sugar rinses produced demineralization lesions within three weeks. Withholding toothbrushing without the extra sugar did not induce such changes. It is this combination of *in vitro*, animal and human studies that has convinced most workers that the frequency of sugar intake is the most important dietary factor in determining caries experience.

Sugar substitutes

Several sweeteners have been studied as alternatives to sugar. Glucose and fructose are among the cheapest, but both are certainly cariogenic and there is no evidence that, if used on a large scale, they would reduce caries experience. Hydrolysed starch, known commercially as 'liquid glucose' as distinct from glucose, may be somewhat less cariogenic. Sorbitol, mannitol, saccharine and aspartame all appear to be noncariogenic. Long term clinical trials using xylitol have been most encouraging. However, sorbitol, mannitol and xylitol can act as mild laxatives. It must be remembered that problems related to sugar substitution are not just limited to sweetness, cost and safety. Sugar gives bulk to many foods and influences physical properties such as viscosity, colloidal stability and plasticity.

Plaque control

Plaque control and dental disease

Based on clinical observation it has been suggested that dental caries can be controlled by highly efficient toothbrushing aimed at reducing plaque formation. This possibility has been investigated in a large number of studies including both large scale surveys and small scale experimental studies. However the results have been inconclusive and have failed to demonstrate a clear association between regular and efficient toothbrushing and a low caries experience. It is for this reason that the majority of experts do not emphasise toothbrushing, in itself, for caries prevention and the public should not be encouraged to depend on toothbrushing alone. For caries prevention the real value of toothbrushing is now thought to be as a means of application of fluoride toothpaste and regular brushing with fluoride toothpaste should be encouraged.

As for periodontal disease, there is ample evidence for an association between plaque and chronic periodontal disease in children and adults. Plaque deposits have been shown to cause a rapid change in the gingival tissue which is reversed by plaque removal. It follows that toothbrushing can be endorsed for the prevention of periodontal disease, although it should be remembered that once bone and gingival tissue have been lost as a result of chronic periodontitis, then personal toothbrushing, although essential, is probably insufficient to stabilize the condition and professional treatment may be needed.

Plaque removal for children

It is generally agreed that most children are incapable of the motivation and manual dexterity required to achieve effective plaque removal with a toothbrush until at least 6–7 years of age. Parents should be advised to brush their children's teeth thoroughly at least once a day. It should be done using a small brush (see page 18) and an

amount of fluoride toothpaste about the size of a small pea in order to avoid unnecessary ingestion by young children. One method of toothbrushing is for the parent to stand behind the child and tilt the child's head upwards so that all tooth surfaces can be brushed using a gentle scrub motion.

Plaque removal for adults

Dentists are generally agreed that of the two most widely taught toothbrushing methods, the roll and the scrub techniques, the scrub is more effective in plaque removal and is more easily taught and accepted. For this reason it is now the method of choice. It should be carried out with a small toothbrush (see below) for ease of access. The method is to place the filaments of the brush at the neck of the tooth and to use very short, horizontal movements to dislodge plaque from the stagnation areas at the gum margins cervically and between the teeth interproximally. Emphasis should be placed on small movements and gentle pressure, together with an unhurried systematic approach to the cleaning of all surfaces. The use of dental floss, sticks and similar aids is clearly of value in individual cases where specific professional advice may be given, but their use should not detract from effective toothbrushing.

Recommended toothbrush specifications

While there is a wide variation in toothbrush design, little evidence exists to support specific recommendations. However, for adults suitable head dimensions appear to be 22–28 mm × 10–13 mm and for children approximately 20 mm × 10 mm seems most suitable. The filaments should be nylon because of its better physical properties and standardisation, with a diameter of 0.15–0.20 mm to give a soft to medium texture. The filaments are best packed densely to give the type of construction sometimes called 'multi-tufted'.

Chemical plaque suppressants

Only chlorhexidine has proved to suppress plaque under clinical conditions. It is on general sale in the UK in mouthrinse and toothpaste forms and is used in the management of periodontal disease. It can cause staining of teeth which is difficult to remove from anterior fillings. However, clinical experience in daily long-term use is limited, two years being the duration of the longest clinical trial reported to date and on present evidence its long-term, unsupervised use cannot be endorsed.

Fluoride

Water fluoridation

The association between the natural presence of fluoride in public water supplies and low caries experience has been demonstrated by over 95 surveys in 21 countries including the UK. These confirm that fluoride in the water at a concentration of about 1 part per million (ppm) is associated with about half the caries experience in comparable nonfluoride areas. In 1945, Grand Rapids in the USA became the first community to have its water supply artificially adjusted to contain 1 ppm fluoride. Since then many cities around the world have followed, the largest scheme in the UK being in Birmingham where the improvement in children's dental health has been dramatic since fluoridation began in 1964.

The safety of water fluoridation is well documented. Numerous studies in both natural and artificially fluoridated areas have failed to show any adverse effect on general health at the level of 1 ppm. One of the most authoritative reports is that of the Royal College of Physicians of London. Its efficacy and safety was upheld in a High Court judgement in Scotland in 1983.

The benefits of water fluoridation can be assessed in several ways. Most epidemiological surveys have shown a reduction in caries experience of 40–70%. Analysis of the reduction in treatment need has shown considerable savings in manpower and resources. A considerable fall in the numbers of extractions and general anaesthetics administered to children has been reported. The overwhelming evidence for the safety and benefits of fluoridation has led to strong support from the Report of the Committee on Child Health Services, the Royal Commission of Inquiry into the Health Service and the report of the Dental Strategy Review Group.

Fluoride dietary supplements

In the absence of the optimum level of fluoride in the water supply, dietary supplements in the form of tablets or drops can be given to obtain similar benefits. These should be given daily throughout the period of tooth development from shortly after birth until adolescence. There is little to be gained by their use during pregnancy. Parents should be advised of the long term commitment in the use of this measure and the need for safe storage away from the reach of children.

The following daily doses are now recommended for areas with less than 0.3 ppm in the water supply.

Age	*Daily dosage*
0–2 years	0.25 mg F (0.55 mg sodium fluoride)
2–4 years	0.5 mg F (1.1 mg sodium fluoride)
4–12 years	1.0 mg F (2.2 mg sodium fluoride)

Some authorities have suggested that the dosage be increased to 1 mg more rapidly and dentists may wish to alter this dosage schedule for individual patients. In areas where the water supply contains from 0.3–0.7 ppm, these dosages should be halved.

Fluoride supplements are available as drops and as 0.25, 0.5 and 1 mg tablets. The choice is one of personal preference, although many mothers find drops more convenient before weaning. If the older children using tablets allow them to dissolve slowly in the mouth, an additional topical benefit will be obtained on erupted teeth.

Topical fluoride agents

A variety of fluoride agents is available for posteruptive application to the teeth for caries prevention. Solutions and gels containing 1–2% sodium fluoride for professional use and mouthrinses for home use are all of proven value. They work by reacting with the surface enamel to reduce its acid solubility and by promoting natural remineralisation. However, fluoride mouthrinses are more cost-effective on a public health basis.

Fluoride toothpaste, which came into general use in about 1974 has shown important caries reductions by virtue of its topical effect. It is regarded by many as the most cost-effective topical fluoride agent for personal use. The value of the routine use of professionally applied topical agents, except for those with high caries activity or the handicapped, may now be regarded as equivocal.

Suggested further reading

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